IN THE TITLE:

LAMINATED MEMBER FOR CIRCUIT BOARD, METHOD AND APPARATUS FOR MANUFACTURING OF CIRCUIT BOARD~~, APPARATUS FOR MANUFACTURING CIRCUIT BOARD~~

IN THE SPECIFICATION:

Please insert the following paragraph at the beginning of the specification.

This application is a 371 of international application PCT/JP2004/000475, which claims priority based on Japanese patent application Nos. 2003-15026, 2003-26797 and 2003-26798 filed January 23, February 4 and February 4, 2003, respectively, which are incorporated herein by reference.

Please replace the paragraph beginning on page 1, line 13, with the following rewritten paragraph:

Concomitant with the reduction in size and weight of electronic products, higher precision in patterning of printed circuit boards has been required. Since flexible film substrates can be bent, which enables three-dimensional wiring, they are suitable for reduction in size of electronic products; hence, the demand for flexible film substrates is increasing. In TAB (tape automated bonding) techniques which are used for connecting ICs to liquid crystal display panels, by processing a relatively narrow, polyimide film substrate, a significantly excellent fine pattern as a resin substrate can be obtained. However, the development of

micro-fabrication is practically reaching its limits. In order to evaluate miniaturization, an index represented by the line width and the space between lines, and an index represented by the position of the pattern on the substrate are used. With respect to the line width and the space between lines, further miniaturization may be possible. The latter index, i.e., the ~~positional~~ dimensional accuracy, relates to the alignment accuracy between a circuit board pattern and electrode pads when the circuit board and electronic components, such as ICs, are connected to each other, and as the pitch between electrode pads of ICs is further narrowed and the number of pins is increased, it becomes difficult to meet the required accuracy. That is, when an IC having more than 400 to 1,000 pins is connected to a circuit pattern, extremely high ~~positional~~ dimensional accuracy is required to align all the pins with fine electrode pads of the circuit pattern with a pitch of 40 µm or less and preferably 30 µm or less.

Please replace the paragraph beginning on page 2, line 17, with the following rewritten paragraph:

It is, in particular, difficult to improve the ~~positional~~ dimensional accuracy of flexible film substrates. In the circuit board fabrication, heat treatment processes, such as drying and

curing, and wet processes, such as etching and development, are performed, and hence the flexible film is repeatedly subjected to expansion and shrinkage. The hysteresis during the fabrication processes mentioned above causes dimensional change of the circuit pattern on the substrate. In addition, when a plurality of processes requires alignment, if expansion and shrinkage occur during such processes, misalignment occurs between patterns to be formed. The deformation of the flexible film due to expansion and shrinkage has a more serious influence on an FPC (Flexible Printing Circuit) in which a substrate having a relatively large work-size is processed. In addition, dimensional change and misalignment are also caused by external forces, such as tension and torsion, and, in particular, when a thin substrate is used to increase flexibility, adequate care must be taken.

Please replace the paragraph beginning on page 5, line 2, with the following rewritten paragraph:

As a method for peeling a flexible film from a rigid substrate, methods have been disclosed in which a flexible film is peeled away while a rigid plate is being held. As particular examples, for example, there may be mentioned methods for peeling a flexible film by lifting up an end portion thereof while the end

portion of the flexible film is held (for example, see Japanese Unexamined Patent Application Publication No. ~~5-319675~~ 7-315682), while a pressure-sensitive adhesive tape is pressed onto the surface of the flexible film (for example, see Japanese Unexamined Patent Application Publication No. ~~7-315682~~ 5-319675), and while a peel angle formed between the rigid substrate and the flexible film is maintained obtuse (for example, see Japanese Unexamined Patent Application Publication No. 2002-104726). In addition, for example, there may also be mentioned a method (for example, see Japanese Unexamined Patent Application Publication No. 7-215577) in which a flexible film is peeled away from a peeling roller using a scraper after the flexible film is transferred onto the peeling roller. However, in all the methods described above, the flexible film used as a protective film is peeled away from a product, and a method for peeling a flexible film having a very fine pattern formed thereon without degrading the dimensional accuracy and flatness has not been described at all.

Please replace the paragraph beginning on page 8, line 12, with the following rewritten paragraph:

Fig. 8 is a schematic front view showing another embodiment of a peeling ~~apparatus~~ unit according to the present invention.

Please replace the paragraph beginning on page 8, line 15, with the following rewritten paragraph:

Fig. 9 is a schematic front view showing another embodiment of a peeling ~~apparatus~~ unit according to the present invention.

Please replace the paragraph beginning on page 10, line 7, with the following rewritten paragraph:

Reference numeral 66 indicates a ~~support~~ body of rotation, and reference numeral 65 indicates a holding portion holding the reinforcing plate. Reference numeral 70 indicates a holding mean. Reference numerals 85 and 86 indicate a press roller and a lift roller, respectively.

Please replace the paragraph beginning on page 12, line 3, with the following rewritten paragraph:

In the present invention, as a substrate used as the reinforcing plate, for example, there may be used inorganic glasses such as soda-lime glass, borosilicate glass, and quartz glass; ceramics, such as alumina, silicon nitride, and zirconia; metals such as stainless steel, invar alloys, and titanium; and glass-fiber reinforced resin sheets. Although all of these materials are preferably used because of their small coefficient of ~~linear~~

thermal expansion and small coefficient of hydroscopic expansion, inorganic glasses are more preferably used. The reasons for this are that the heat resistance and resistance to chemicals in a circuit pattern-forming step are excellent, a large-area substrate having a satisfactory surface smoothness is easily obtained at a reasonable price, plastic deformation is unlikely to occur, and particles are unlikely to be generated by contact which occurs during transportation. Among the inorganic glasses, a borosilicate glass represented by aluminoborosilicate glass is most preferably used since it has a high elastic modulus and a small coefficient of thermal expansion.

Please replace the paragraph beginning on page 12, line 23, with the following rewritten paragraph:

When a metal or a glass-fiber reinforced resin is used as the reinforcing plate, although formation may be performed by reel to reel process, continuous sheet; however, since the ~~positional~~ dimensional accuracy can be easily ensured, the circuit board of the present invention is preferably formed by a single sheet process. In addition, in mounting electronic components, the single sheet process is also preferably performed since alignment is easily performed with high accuracy by using optical position

detection, a movable stage, and the like. In this embodiment, the single sheet process indicates a process in which, instead of a long, continuous sheet, a plurality of sheets is handled sheet by sheet.

Please replace the paragraph beginning on page 13, line 10, with the following rewritten paragraph:

When a glass substrate is used as the reinforcing plate, if the glass substrate has a small Young's modulus or the glass substrate is thin, since warpage and torsion are increased by the expansion and shrinkage of the flexible film, the glass substrate may be cracked in some cases when being performed vacuum-suction onto a flat stage. Additionally, since the flexible film is deformed by vacuum- suction and release, it tends to be difficult to ensure the ~~positional~~ dimensional accuracy. On the other hand, if the glass substrate is thick, the flatness may be degraded due to non-uniform thickness in some cases, resulting in degradation in exposure accuracy. In addition, since handling load by a robot or the like increases, it becomes difficult to transfer substrates quickly, and hence, besides decrease in productivity, transportation cost is increased. In consideration of the points described above, the thickness of a glass substrate used as a

single-sheet reinforcing plate (which is to be treated by a single sheet process) is preferably in the range of 0.3 to 1.1 mm.

Please replace the paragraph beginning on page 14, line 4, with the following rewritten paragraph:

When a metal substrate is used as the reinforcing plate, if the metal substrate has a small Young's modulus or the metal substrate is thin, since warpage and torsion are increased by the expansion and shrinkage of the flexible film, it becomes impossible to perform vacuum-suction of the substrate onto a flat stage, or since the flexible film is deformed in accordance with the warpage and torsion of the metal substrate, it becomes difficult to ensure the ~~positional~~ dimensional accuracy. In addition, if bending occurs, the flexible film is immediately rejected as a defect. On the other hand, if the metal substrate is thick, flatness may be degraded in some cases due to non-uniform thickness, resulting in degradation in exposure accuracy. In addition, since handling load by a robot or the like increases, it becomes difficult to transfer substrates quickly, and hence, besides decrease in the productivity, transportation cost is also increased. Accordingly, the thickness of a metal substrate used as the single-sheet reinforcing plate is preferably in the range of 0.1 to 0.7 mm.

Please replace the paragraph beginning on page 15, line 14, with the following rewritten paragraph:

In addition, an adhesive having adhesion to be decreased in a low temperature region, an adhesive having adhesion to be decreased by ultraviolet irradiation, or an adhesive having adhesion to be decreased by heat treatment may also be preferably used. Among those mentioned above, the adhesive having adhesion to be decreased by ultraviolet irradiation is more preferably used since the change in adhesion is significant before and after the ultraviolet irradiation, and due to crosslinking of the adhesive caused by ultraviolet irradiation before bonding of electronic components performed under <u>high</u> temperature and <u>high</u> pressure conditions, softening due to the temperature and deformation due to the pressure can be preferably suppressed. In addition, in order to ensure resistance to chemicals and heat resistance in a process for forming a circuit pattern, crosslinking of the adhesive by ultraviolet irradiation is preferably performed prior to the start of a wet process and a heating process in the process for forming a circuit pattern. As the adhesive having adhesion or tackiness to be decreased by ultraviolet irradiation, a two-component cross-linkable acrylic-based pressure-sensitive adhesive may be mentioned by way of example. In addition, as the adhesive having adhesion or

tackiness to be decreased in a low temperature region, for example, there may be mentioned an acrylic-based pressure-sensitive adhesive which is reversibly transformed between the crystalline state and the non-crystalline state.

Please replace the paragraph beginning on page 28, line 7, with the following rewritten paragraph:

In the present invention, after the circuit pattern is formed on the surface of the flexible film opposite to that adhered to the reinforcing plate as described above, the flexible film may be peeled away therefrom, or after electronic components are further bonded to the circuit pattern, the flexible film may be peeled away from the reinforcing plate. When the flexible film is peeled away from the reinforcing plate after the electronic components are bonded to the circuit pattern, it is preferable since the ~~positional~~ <u>dimensional</u> accuracy of the circuit pattern is highly maintained, and the alignment accuracy with the electronic components can be improved.

Please replace the paragraph beginning on page 28, line 19, with the following rewritten paragraph:

In a method for bonding the electronic components, such as

ICs, to the circuit board, in particular, in a method for simultaneously bonding many connection portions to each other, it is important to ensure the ~~positional~~ <u>dimensional</u> accuracy. As the bonding methods, for example, there may be mentioned a method in which a metal layer composed of tin, gold, solder, or the like formed on connection portions of a circuit board is metal-bonded to a metal layer composed of gold, solder, or the like formed on connection portions of electronic components by thermal pressure bonding; and a method in which, while a metal layer composed of tin, gold, solder, or the like formed on connection portions of a circuit board is pressed onto a metal layer composed of gold, solder, or the like formed on connection portions of electronic components, an anisotropic conductive adhesive or nonconductive adhesive placed between the circuit board and the electronic components is cured so as to achieve mechanical bonding.

Please replace the paragraph beginning on page 33, line 23, with the following rewritten paragraph:

Fig. 1 is a schematic front view showing a peeling apparatus 1 of the present invention, Figs. 2, ~~8, and 9~~ <u>10, and 11</u> are schematic front views showing other embodiments using the peeling apparatus 1, and Figs. 3 to 7 are schematic front views showing

other embodiments of a support body 12 which is one element of the peeling apparatus 1. In addition, Fig. 9 is a schematic front view of a peeling unit 45 which is another embodiment of a peeling unit 10 used for the peeling apparatus 1. Furthermore, Fig. 16(a) is a schematic front view of a peeling apparatus 150 of the present invention for illustrating a particular example of means for monitoring a roll surface speed of a flexible-film support surface of the support body 12, a relative moving speed thereof with respect to a reinforcing plate 2, and a tension applied to the flexible film so as to set the upper limit, and Fig. 16(b) is a side view of the peeling apparatus 150.

Please replace the paragraph beginning on page 54, line 1, with the following rewritten paragraph:

In the peeling apparatus 150, the setting of the ratio V1/V2>1, and the control of limiting the tension applied to the flexible film is performed by the torque control by a control device [[212]] <u>162</u> using the above electromagnetic clutch [[206]] <u>156</u>. In addition to that described above, the speed control of the roll surface speed V1 of the holding surface of the holding portion 14 and the speed control of the relative moving speed V2 can also be performed. In the speed control described above, the limit

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torque is first increased by increasing the supply voltage to the electromagnetic clutch 156 so that the rotation of the support body 12 is not placed in a slipping state with respect to the rotation of the rotary motor 160, and that the rotation speed of the rotary motor 160 and the relative moving speed V2 of the frame 18 by the linear motor 158 are controlled so that the ratio V1/V2 has an appropriate value of more than 1 ~~or more~~. Since the tension applied to the flexible film 4 is increased as the ratio V1/V2 is increased, the ratio V1/V2 is set so that the tension has a limited value.

Please replace the paragraph beginning on page 55, line 3, with the following rewritten paragraph:

Instead of the torque control using the electromagnetic clutch 156, there may also be used another mechanical torque control system such as a slip ring or an electronic torque control system realized by combination of a torque sensor and a servomotor. In addition, the combination of the mechanical and electronic torque control systems can also be used. The ratio V1/V2 of the roll surface speed V1 of the holding surface of the holding portion 14 to the relative moving speed V2 of the frame 18 is preferably set to 1.01 or more. The limit value of the torque applied to the

support body 12 and that of the tension applied to the flexible film 4 must be set in the range so that the increase in peel angle concomitant with the progress of peeling is satisfactorily prevented and so that the circuit pattern made of a metal and the flexible film are not plastic-deformed, and hence the limit values are optionally selected in consideration of the material, the width, and the thickness of the flexible film. The tension per unit area applied to the flexible film 4 is 2.4×10^7 N/m^2 or less, more preferably 1.2×10^7 N/m^2 or less, and most preferably 8×10^6 N/m^2 or less.

Please replace the paragraph beginning on page 55, line 24, with the following rewritten paragraph:

A method for peeling the flexible film 4 using the peeling apparatus 150 is performed in the same manner as that in the method for peeling the flexible film 4 by the peeling apparatus 1 except that by using the control device 162, 1) V1/V2 is set to an appropriate value of ~~more than~~ 1 or more so that the peel angle 38 has a desired value, 2) speed control of the motor 160 is performed so that the roll surface speed V1 of the holding surface of the holding portion 14 has a predetermined value, 3) speed control is performed by driving the linear motor 158 so that the relative

moving speed V2 of the frame 18 has a predetermined value, and 4) the torque applied to the support body 12 is limited by adjusting the supply voltage to the electromagnetic clutch 156 so that the tension applied to the flexible film 4 in peeling is limited.

Please replace the paragraph beginning on page 57, line 1, with the following rewritten paragraph:

The peeling mean 42 can hold the end of the flexible film 4 and pull it while the peel angle [[40]] <u>38</u> is stably maintained in the range of more than 0 to 80° by a drive source not shown in the figure; however, in order to more stably control the peel angle [[40]] <u>38</u>, the peeling unit 45 described below is preferably used.

Please replace the paragraph beginning on page 58, line 14, with the following rewritten paragraph:

Alternatively, as another embodiment, when the peeling mean 47 holds the end portion of the flexible film 4 by the drive source not shown in the figure and pulls it in synchronous with the movement of the frame 50 in the direction indicated by the arrow, that is, in the direction to the left side in Fig. 9, the peeling can be performed while the peel angle 38 is maintained in the range of <u>more than</u> 0° to 80°. When the peeling is performed, the loading

table 46 may be stopped or may be moved in the direction opposite to that of the movement of the frame 50.

Please replace the paragraph beginning on page 59, line 18, with the following rewritten paragraph:

Another embodiment of the peeling method of the present invention will be described using a peeling ~~apparatus~~ unit 40 shown in Fig. 8. The primary structure of the peeling ~~apparatus~~ unit 40 shown in Fig. 8 is as follows. The peeling ~~apparatus~~ unit 40 is composed of the loading table 41 and the peeling mean 42, the loading table 41 being provided for holding the reinforcing plate 2, which is the glass substrate, of the flexible film substrate 6 composed of the reinforcing plate 2 and the flexible film 4 adhered thereto with the removable organic layer 3 interposed therebetween, the peeling member 42 being provided for holding the flexible film 4 and pulling it in the direction extending along the peel angle 38 indicated by the arrow so as to peel away the flexible film 4 from the removable organic layer 3.

Please replace the paragraph beginning on page 60, line 7, with the following rewritten paragraph:

The peeling mean 42 holds the end portion of the flexible film

4 and pulls it by the drive source not shown in the figure while the peel angle 38 is maintained in the range of more than 0° ~~or more~~ and preferably in the range of 1° to 80°, thereby performing the peeling.

Please replace the paragraph beginning on page 60, line 12, with the following rewritten paragraph:

Another embodiment of the peeling method of the present invention will be described using a peeling ~~apparatus~~ unit 45 shown in Fig. 9. The primary structure of the peeling ~~apparatus~~ unit 45 shown in Fig. 9 is as follows. The peeling ~~apparatus~~ unit 45 is composed of the loading table 46, the peeling mean 47, and the support roller 49, the loading table 46 being provided for holding the reinforcing plate 2, which is the glass substrate, of the flexible film substrate 6 composed of the reinforcing plate 2 and the flexible film 4 adhered thereto with the removable organic layer 3 interposed therebetween, the peeling mean 47 being provided for holding the flexible film 4 and pulling it in the direction extending along the peel angle 38 indicated by the arrow so as to peel away the flexible film 4 from the removable organic layer 3, the support roller 49 being provided for supporting the flexible film 4 in peeling. A support roller [[48]] 49 is fitted to the

frame 50.

Please replace the paragraph beginning on page 61, line 11, with the following rewritten paragraph:

When the peeling mean 47 holds the end portion of the flexible film 4 by the drive source not shown in the figure and pulls it in the direction extending along the peel angle 38 indicated by the arrow in synchronous with the movement of the loading table 46, the flexible film 4 can be peeled away while the peel angle 38 is maintained in the range of <u>more than</u> 0° to 80°.

Please replace the paragraph beginning on page 61, line 18, with the following rewritten paragraph:

Alternatively, as another embodiment, when the peeling mean 47 holds the end portion of the flexible film 4 by the drive source not shown in the figure and pulls it in synchronous with the movement of the frame 50 in the direction to the left side in the figure, the peeling can be performed while the peel angle 38 is maintained in the range of <u>more than</u> 0° to 80°.

Please replace the paragraph beginning on page 62, line 20, with the following rewritten paragraph:

First, the peeling apparatus 60 shown in Fig. 10 will be described. In Fig. 10, the peeling apparatus 60 is shown which peels the flexible film substrate 6 composed of a reinforcing plate [[4]] 2, which is a glass substrate, and a flexible film [[2]] 4 adhered thereto with the removable organic layer 3 such as a pressure-sensitive adhesive interposed therebetween. The peeling apparatus 60 is composed of a loading table 61, a peeling unit 62, and a loading table 63, the loading table 61 being provided for holding the flexible film substrate 6 at a non-adhering surface thereof, the peeling unit 62 being provided for actually peeling the reinforcing plate [[4]] 2 away from the flexible film [[2]] 4, the loading table 63 being provided for receiving the reinforcing plate [[4]] 2 after peeling.

Please replace the paragraph beginning on page 63, line 18, with the following rewritten paragraph:

Next, the peeling unit 62 is composed of a body of rotation 66 having at the surface thereof a holding portion 65 which defines the amount of deformation of the reinforcing plate [[4]] 2, a frame 68 cantilevering the body of rotation 66 with a shaft 67 so that the body of rotation 66 is freely rotatable thereabout, and a rail 69 freely guiding the frame 68 on the base table 64 in the

horizontal direction. The holding portion 65 is formed of an elastic material such as a rubber, and suction holes are provided in the surface. By a vacuum source not shown in the figure, parts to be brought into contact with the reinforcing plate [[4]] 2 can be performed vacuum-suction. The suction holes provided in the holding portion 65 are formed so that parts at which the reinforcing plate [[4]] 2 and the holding portion 65 are brought into contact with each other are sequentially sucked. In addition, in order to hold the reinforcing plate [[4]] 2 while it is being curved, the holding surface of the holding portion 65 has a curved surface.

Please replace the paragraph beginning on page 64, line 11, with the following rewritten paragraph:

The curvature radius of the curved surface described above is formed in consideration of the peeling performance and the amount of deformation acceptable for the reinforcing plate [[4]] 2. The dimension of the curvature radius is preferably in the range of 20 to 1,000 mm and more preferably in the range of 50 to 800 mm. When the reinforcing plate is a glass substrate, the curvature radius is preferably in the range of 400 to 1,000 mm and more preferably in the range of 500 to 800 mm. When the curvature radius is too

small, the reinforcing plate may be put outside a plastic deformation region and may be damaged so that peeling thereof cannot be further performed, or the reinforcing plate may be deformed so that reusing of the reinforcing plate after peeling cannot be performed. When the curvature radius is too large, a force for peeling the reinforcing plate becomes deficient, and as a result, peeling cannot be performed in synchronous with the movement of the holding portion 65.

Please replace the paragraph beginning on page 65, line 4, with the following rewritten paragraph:

Furthermore, the rotation of the body of rotation 66 and the horizontal movement of the frame 68 are independently performed by drive motors not shown in the figure and are synchronously controlled so that a contact portion between the holding portion 65 and the reinforcing plate [[4]] 2 is sequentially moved in the horizontal direction (direction indicated by a horizontal arrow in the figure). Since the loading table 61 is freely moved up and down, in peeling the reinforcing plate [[4]] 2 from the flexible film [[2]] 4, the loading table 61 is moved in the vertical direction and is stopped at a position at which the reinforcing plate [[4]] 2 and the holding portion 65 is brought into contact

with each other at a predetermined pressure. On the other hand, the loading table 63 is provided for receiving the reinforcing plate [[4]] 2 thereon which is vacuum-sucked to the holding portion 65 of the peeling unit 62. That is, after the peeling is complete, while vacuum-suction the reinforcing plate [[4]] 2, the peeling unit 62 is moved to the loading table 63 as shown by dotted lines in Fig. 10. After the distance between the reinforcing plate held by the holding portion 65 and the loading table 63 is controlled preferably in the range of 0.1 to 3 mm and more preferably in the range of 0.1 to 1 mm by moving the loading table 63 in the vertical direction, the vacuum-suction is released so as to separate the reinforcing plate [[4]] 2 from the holding portion 65, and as a result, the reinforcing plate [[4]] 2 is transferred onto the loading table 63.

Please replace the paragraph beginning on page 66, line 6, with the following rewritten paragraph:

Next, a method for peeling the flexible film [[2]] 4 using the peeling apparatus 60 shown in Fig. 10 will be described.

Please replace the paragraph beginning on page 66, line 8, with the following rewritten paragraph:

After the loading table 61 is moved to the lowest point, by transfer means not shown in the figure, the flexible film substrate 6 is placed on the loading table 61 so that the flexible film [[2]] 4 is located at the lower side (the reinforcing plate [[4]] 2 is located at the upper side). Subsequently, the vacuum source not shown in the figure is driven, so that the flexible film substrate 6 is held on the loading table 61 by vacuum-suction. Next, in order to position a start point S of the holding potion 65 of the peeling unit 62 at a position over the right end of the reinforcing plate [[4]] 2 in the figure, the frame 68 is moved, and the body of rotation 66 is moved by rotation. After the positioning of the holding portion 65 described above is complete, the loading table 61 is moved upward, and the right end of the reinforcing plate [[4]] 2 and the start point S of the holding portion 65 are brought into contact with each other at a predetermined pressure. The pressure is preferably in the range of 0.001 to 1 MPa and more preferably in the range of 0.01 to 0.2 MPa.

Please replace the paragraph beginning on page 67, line 2, with the following rewritten paragraph:

While the state described above is being maintained, the vacuum source not shown in the figure is driven, so that the

holding portion 65 is vacuum-sucked to the reinforcing plate [[4]] 2. Subsequently, the movement of the frame 68 to the left side and the rotation of the body of rotation 66 anticlockwise are synchronously performed, so that the curved surface of the holding portion 65 is sequentially brought into contact with the upper surface of the reinforcing plate [[4]] 2 from the right side. Accordingly, since being sequentially curved from the right side, the reinforcing plate [[4]] 2 is being separated from the flexible film [[2]] 4, and as a result, the peeling between the two described above is sequentially performed from the right side. When an end point E of the holding portion 65 reaches the left end of the reinforcing plate [[4]] 2, comes into contact with the left end thereof, and passes therethrough, the peeling is complete. When the peeling is complete, the movement of the frame 68 and the rotation of the body of rotation [[65]] 66 are stopped, and the loading table 61 is moved downward, so that the reinforcing plate [[4]] 2 and the flexible film [[2]] 4 are substantially separated from each other.

Please replace the paragraph beginning on page 67, line 23, with the following rewritten paragraph:

Subsequently, the body of rotation 66 is rotated clockwise so

that the central portion of the reinforcing plate [[4]] 2 vacuum-sucked to the holding portion 65 is placed at the lowest position. The frame 68 is then moved in the right direction, so that the reinforcing plate [[4]] 2 held by the holding portion 65 is placed over the loading table 63. Next, the loading table 63 is moved upward so that the space between the upper surface of the loading table 63 and the lowest point of the reinforcing plate [[4]] 2, which is the central portion thereof, is 0.1 to 1 mm. After the space described above is ensured, the adsorption by the holding portion 65 is released, so that the reinforcing plate [[4]] 2 is transferred onto the loading table 63. After the transfer is complete, the vacuum-suction by the loading table is released, and by a transfer device not shown in the figure, the separated the reinforcing plate [[4]] 2 and the flexible film [[2]] 4 are individually transferred to subsequent steps. Subsequently, after the peeling unit 62 is returned to the original position, the same steps as described above are then repeatedly performed, so that peeling of the following flexible film substrate 6 is performed.

Please replace the paragraph beginning on page 68, line 19, with the following rewritten paragraph:

In a peeling apparatus shown in Fig. 11, a holding mean 70

having a hook shape for holding one end portion of the reinforcing plate [[4]] 2 is fixed to one end of the body of rotation 66 of the peeling apparatus 60 shown in Fig. 10. A material for the holding mean 70 is not particularly limited, and for example, a metal, a resin, and a ceramic may be used. However, a composite structure is preferably used in which a main body is made of a metal and a contact part with the reinforcing plate [[4]] 2 is made of a soft material such as a rubber or a resin.

Please replace the paragraph beginning on page 69, line 6, with the following rewritten paragraph:

The loading table 61 is moved down to the lowest position, and the frame 68 is then moved to the right side so that the holding portion 65 is not located over the loading table 61. While the state described above is being maintained, by the transfer means not shown in the figure, the flexible film substrate 6 is placed on the loading table 61 so that the flexible film [[2]] 4 is located at a lower side (the reinforcing plate [[4]] 2 is located at an upper side). Subsequently, by using the vacuum source not shown in the figure, the flexible film substrate 6 is held on the loading table 61 by vacuum-suction.

Please replace the paragraph beginning on page 69, line 17, with the following rewritten paragraph:

Next, the loading table 61 is moved upward so that a part of the holding mean 70 having a hook shape is placed at a position corresponding to the right end portion of the reinforcing plate [[4]] <u>2</u>. Then, the frame 68 is moved to the left side so that the right end portion of the reinforcing plate [[4]] <u>2</u> is fitted into the hook-shaped portion of the holding mean 70 as shown in Fig. 11, and hence the holding mean 70 can hold the right end portion of the reinforcing plate [[4]] <u>2</u>. In this case, the gap between the hook-shaped portion of the holding mean 70 and the right end portion of the reinforcing plate [[4]] <u>2</u> in the thickness direction is preferably in the range of 0.1 to 5 mm and more preferably 0.5 to 1.5 mm.

Please replace the paragraph beginning on page 70, line 5, with the following rewritten paragraph:

Subsequently, while the state described above is being maintained, by ~~driving a vacuum~~ <u>a drive</u> source not shown in the figure, the movement of the frame 68 in the left direction and the rotation of the body of rotation 66 anticlockwise are synchronously performed, so that the curved surface of the holding portion 65 is

sequentially brought into contact with the upper surface of the reinforcing plate [[4]] 2 from the right side. Accordingly, while being curved, the reinforcing plate [[4]] 2 is sequentially lifted upward from the right end portion thereof so as to be separated from the flexible film [[2]] 4 which is held by vacuum-suction, and as a result, the two described above are sequentially separated from the right side. When the end point E of the holding portion 65 reaches the left end of the reinforcing plate [[4]] 2, comes into contact with the left end thereof, and passes therethrough, the peeling is complete. When the peeling is complete, the movement of the frame 68 and the rotation of the body of rotation 66 are stopped, and the loading table 61 is moved downward, so that the reinforcing plate [[4]] 2 and the flexible film [[2]] 4 are substantially separated from each other.

Please replace the paragraph beginning on page 71, line 1, with the following rewritten paragraph:

Subsequently, the body of rotation 66 is rotated clockwise so that the central portion of the reinforcing plate [[4]] 2 vacuum-sucked to the holding portion 65 is located at the lowest position. The frame 68 is then moved to the right side so that the reinforcing plate [[4]] 2 held by the holding portion 65 is placed

at a position over the loading table 63. Next, the loading table 63 is moved upward so that the space between the upper surface of the loading table 63 and the lowest point of the reinforcing plate [[4]] 2, which is the central portion thereof, is 0.1 to 1 mm. After the space described above is ensured, the vacuum-suction by the holding portion 65 is released, so that a part of the reinforcing plate [[4]] 2 is transferred onto the loading table 63.

Please replace the paragraph beginning on page 71, line 14, with the following rewritten paragraph:

Next, the frame 68 is further moved to the right side so that the right end portion of the reinforcing plate [[4]] 2 is disengaged from the hook-shaped portion of the holding mean 70, and hence the reinforcing plate [[4]] 2 is totally transferred onto the loading table 63. When the transfer is complete, the loading table 63 is moved downward to the lowest position, and the vacuum-suction by the loading table 63 is released. Next, by the transfer device not shown in the figure, the separated reinforcing plate [[4]] 2 and the flexible film [[2]] 4 are individually transferred to subsequent steps. Subsequently, after the peeling unit 62 is returned to the original position, the same steps as described above are then repeatedly performed, so that peeling of the

following flexible film substrate 6 is performed.

Please replace the paragraph beginning on page 72, line 5, with the following rewritten paragraph:

The peeling apparatus 80 is composed of the loading table 81 directly holding the flexible film [[2]] 4 side of the flexible film substrate 6 and a peeling unit 81 peeling the reinforcing plate [[4]] 2 of the flexible film substrate 6 from the flexible film [[2]] 4. The loading table 81 is guided by a guide 84 provided on a base table 83 and is freely movable along the horizontal direction by a drive source not shown in the figure. In addition, suction holes are provided in the surface of the loading table 81, and by connection with a vacuum source not shown in the figure, the flexible film [[2]] 4 of the flexible film substrate 6 can be held by vacuum-suction using an vacuum-suction effect obtained from the suction holes.

Please replace the paragraph beginning on page 72, line 18, with the following rewritten paragraph:

The peeling unit 82 is composed of a press roller 85, a lift roller 86, these two rollers sandwiching the reinforcing plate [[4]] 2, and a roller group 87 holding the reinforcing plate [[4]]

2 after the flexible film [[2]] 4 is peeled away. The press roller 85 and the lift roller 86 each cantilevered by a rotation table 88 so as to be in a free rotation state. The press roller 85 is preferably a rubber roller. In addition, the rotation table 88 is fitted in a free rotation state to a lift table 89 by a rotation shaft coaxial with the rotation center of the press roller 85. Furthermore, this lift table 89 is fitted to a base frame 90 so as to be freely moved up and down. By the motion of the lift table 89, the rotation table 88 can be freely moved in the vertical direction. In addition, the roller group 87 is also held by the base frame 90 in a free rotation state.

Please replace the paragraph beginning on page 73, line 10, with the following rewritten paragraph:

First, the loading table 81 is moved to the left end so as not to interfere with the press roller 85 and the lift roller 86. In the state described above, by transfer means not shown in the figure, the flexible film substrate 6 is placed on the loading table 81 so that the flexible film [[2]] 4 is located at a lower side (the reinforcing plate [[4]] 2 is located at an upper side). Subsequently, by driving the vacuum source not shown in the figure, the flexible film substrate 6 is held on the loading table 81 by

vacuum-suction.

Please replace the paragraph beginning on page 73, line 20, with the following rewritten paragraph:

Next, in the state described above, before the loading table 81 is moved to the right side, the position in the vertical direction and the rotation angle of the rotation table 88 is adjusted so that the reinforcing plate [[4]] 2 is allowed to pass between the press roller 85 and the lift roller 86 as shown in Fig. 12(a). After the preparation described above is complete, the loading table 81 is actually moved to the right side and is stopped at a position at which the under surface at the right end of the reinforcing plate [[4]] 2 of the flexible film substrate 6 is placed over the lift roller [[76]] 86, the flexible film substrate 6 being held on the ~~loading~~ rotation table [[81]] 88 by adsorption[[,]].

Please replace the paragraph beginning on page 74, line 7, with the following rewritten paragraph:

Subsequently, the rotation table [[78]] 88 is moved downward and is stopped at a position at which the press roller 85 presses the reinforcing plate [[4]] 2 at a predetermined pressure. The

pressure in this case is preferably in the range of 0.001 to 1 MPa and more preferably in the range of 0.01 to 0.2 MPa.

Please replace the paragraph beginning on page 74, line 13, with the following rewritten paragraph:

Next, the rotation table 88 is slowly rotated anticlockwise around the center of the press roller 85 as a rotation axis, and as shown in Fig. 12(b), the right end of the reinforcing plate [[4]] 2 is lifted by the lift roller 86, so that the peeling of the reinforcing plate [[4]] 2 from the flexible film [[2]] 4 starts. When the right end of the reinforcing plate [[4]] 2 is lifted to a predetermined level, the anticlockwise rotation of the rotation table 88 is stopped, and the loading table 81 is then moved to the right side at a predetermined speed. As the loading table 81 is moved to the right side, a peel point between the reinforcing plate [[4]] 2 and the flexible film [[2]] 4 is moved to the left side, and concomitant with this movement, the peeling progresses. When the left side of the reinforcing plate [[4]] 2 passes through the press roller 85, the reinforcing plate [[4]] 2 thus peeled away is then transferred onto the roller group 87 by inertia. After the vacuum-suction by the loading table 81 is released, by a transfer device not shown in the figure, the separated reinforcing plate

[[4]] 2 and the flexible film [[2]] 4 are individually transferred to subsequent steps.

Please replace the paragraph beginning on page 75, line 12, with the following rewritten paragraph:

When a circuit pattern (not shown) is provided on the flexible film [[2]] 4 or the electronic components 5 such as IC chips are further mounted on the circuit pattern, recess portions [[90]] 91 are preferably provided in a loading table [[51]] 61, a loading table [[53]] 63, and the loading table 81 as shown in Fig. 13 so that the electronic components 5 will not interfere with operations. The change in size of the recess portion [[90]] 91 may be performed using an adaptor. As for the size of the recess portion corresponding to an IC chip, for example, the depth is 0.5 to 2 mm and the length and the width are each 1 to 20 mm. In addition, a suction hole may also be provided in a bottom surface [[91]] 92 of the recess portion [[90]] 91 so that the electronic component 5 is brought into contact with the bottom surface [[91]] 92 and is then fixed to the loading table by vacuum-suction. Furthermore, the loading table may be formed of a flexible raw material having micropores which can perform vacuum-suction so that the electronic component 5 is buried in this raw material and is

fixed by vacuum-suction.

Please replace the paragraph beginning on page 76, line 18, with the following rewritten paragraph:

A method for holding the flexible film [[2]] 4 by the loading tables [[51]] 61 and 81 is not particularly limited, and besides the vacuum-suction described in the above embodiment, electrostatic suction may also be used. For performing electrostatic suction, it is preferable that the loading table be conductive, and be at a ground potential or an optional voltage be applied in accordance with a method for applying static electricity. In addition, in order to decrease the peeling force of an organic layer, a heating element is preferably provided in or on the loading table. For the same purpose as described above, a heating element is preferably provided for a holding portion [[55]] 65 of a peeling unit [[52]] 62.

Please replace the paragraph beginning on page 85, line 1, with the following rewritten paragraph:

Fig. 17 is a schematic front cross-sectional view (cross-sectional portions are shown by black areas and by areas of oblique lines) of a central portion of a laminator [[1]] 200.

Please replace the paragraph beginning on page 86, line 25, with the following rewritten paragraph:

An electrostatic charging device [[203]] <u>204</u> extends in the width direction of the loading table 201 to have a length larger than that in the width direction of the loading table 201 and is supported by a support pillar 215 provided on the base table 205. The support pillar 215 is moved by a vertical movement mechanism not shown in the figure so that the electrostatic charging device [[203]] <u>204</u> will not interfere with the frame 213 and the squeegee holder 214, which are moved in the horizontal direction in Fig. 17. The electrostatic charging device 204 sprays ionic air having a negative or a positive charge onto a workpiece disposed thereunder, the stream of the ionic air having a width at least equivalent to that of the loading table 201, and when the flexible film 4 sucked to the loading table 201 passes under the electrostatic charging device 204, a suction force by electrostatic charge can be imparted to the flexible film 4. In addition, as is the case described above, when the electrostatic charging device 204 passes over the film holding sheet 202, a suction force by electrostatic charge can also be imparted to the film holding sheet 202. In this embodiment, the upper surface of the reinforcing plate 2 is coated with the removable organic layer 3 beforehand.

Please replace the paragraph beginning on page 87, line 22, with the following rewritten paragraph:

Next, a lamination method using the laminator [[1]] 200 will be described with reference to ~~Fig. 18~~ Figs. 17 and 18. Fig. 18 includes schematic front views showing a procedure of a lamination method of the present invention.

Please replace the paragraph beginning on page 88, line 1, with the following rewritten paragraph:

First, the loading table 201 is moved to the left end shown by a dotted line in ~~Fig. 18~~ Fig. 17 and is then stopped, and by a transfer device (not shown), the flexible film 4 is placed on the loading table 201 and fixed by suction (Fig. 18(a)). Next, while the loading table 201 is being moved to the right side at a predetermined rate, the flexible film 4 is allowed to pass under the electrostatic charging device 204 which sprays positively charged ionic air in a downward direction, so that the flexible film 4 is positively charged. When reaching a position right under the film holding sheet 202, the loading table 201 is stopped, and the suction of the flexible film 4 is released. Next, by driving the linear cylinder not shown in the figure downward, the film holding sheet 202 is moved close to the flexible film 4 and is then

stopped when the space therebetween becomes a predetermined value (Fig. 18(b)). The space between the flexible film 4 and the film holding sheet 202 is preferably 10 mm or less; however, the surface of the flexible film 4 and that of the film holding sheet 202 may also be brought into contact with each other. Subsequently, after the squeegee 203 is pressed onto the upper side (opposite to the surface holding the flexible film 4) of the film holding sheet 202 so as to sandwich the film 4 between the film holding sheet 202 and the upper surface of the loading table 201, the squeegee 203 is moved from the left side to the right side of the flexible film 4, so that the flexible film 4 on a ~~stage 203~~ squeegee 203 is transferred to the film holding sheet 202 by an electrostatic force (Fig. 18(c)).

Please replace the paragraph beginning on page 104, line 4, with the following rewritten paragraph:

While the water-vapor blocking film composed of a polyester film and a silicone resin layer was being peeled, the polyimide film was laminated onto the glass provided with the removable organic layer formed thereon by the laminator shown in ~~Fig. 16~~ Fig. 17. In this step, the structure was formed so that three sides of the glass and three sides of the polyimide film were flush with

each other and that the remaining one side of the polyimide film protruding from the corresponding one side of the glass by 2 mm. Subsequently, the laminate thus formed was irradiated with ultraviolet rays at 1,000 mJ/cm^2 from the glass substrate side, so that a removable agent layer was cured.

Please replace the paragraph beginning on page 122, line 4, with the following rewritten paragraph:

Except that the speed of the rotation motor 160 was controlled so that the roll surface speed V1 of the holding surface of the holding portion 14 was set to 0.3 m/minute, and that the rightward relative moving speed V2 of the frame 18 in peeling was set to the same as that described above, the peeling was performed in the same manner as that in EXAMPLE [[10]] <u>12</u>. In the peeling, the peel angle [[40]] <u>38</u> between the reinforcing plate and the flexible film exceeded 80° nearly at the end of the peeling of the flexible film in some cases, and the flexible film provided with the circuit pattern was strongly curled in the vicinity of a position at which the peeling is almost complete. When the distance between the two points provided on the peeled polyimide film for the dimensional length measurement, which was originally approximately 283 mm (distance of 200 mm in the x direction and distance of 200 mm in

the y direction) in the diagonal line direction, was measured, some data showed an increase of up to 30 μm with respect to the photomask pattern.